

**ISI Water Quality Studies for the In-Delta Storage Program**  
**DWR Delta Modeling Work Plan**  
**May 2001 Revision #2**

*CALFED stakeholders were briefed on the proposed work plan on February 13, 2001 through the Drinking Water Quality Operations Workgroup. This is a revision to the March 19, 2001 draft work plan.*

**I. DSM2 STUDIES**

**1. Evaluate Delta Wetlands 2000 Revised EIR/S Operations Studies**

**Purpose:** To evaluate water quality impacts of operating DW Project according to assumptions in EIR/S. Water quality impacts will be measured against the objectives outlined in D-1641, D-1643 and the DW Water Quality Management Plan (WQMP).

**Description:** David Forkel provided us with Jones and Stokes' base and plan operations study results in Excel format. The base study represents the No Action Alternative and the plan study represents unlimited South of Delta demand (Scenario #1). Ten DSM2 simulations of the period 1976-91 will be conducted, employing the EIR/S hydrology and operations and bookend water quality assumptions:

Study 1: Base Case (No Action) -- EC  
Study 2: Base Case (No Action) -- DOC  
Study 3: Base Case (No Action) -- UV-254  
Study 4: DW Operations -- EC  
Study 5: DW Operations (6 mg/L DOC release) -- DOC  
Study 6: DW Operations (15 mg/L DOC release) -- DOC  
Study 7: DW Operations (30 mg/L DOC release) -- DOC  
Study 8: DW Operations (6 mg/L DOC release) -- UV-254  
Study 9: DW Operations (15 mg/L DOC release) -- UV-254  
Study 10: DW Operations (30 mg/L DOC release) -- UV-254

**Duration:** 1 month

**Expected Start Date:** March 2001

**Expected End Date:** April 2001

**Product:** A memorandum report will be prepared summarizing study assumptions and results.

## 2. Evaluate In-Delta Storage Alternatives with Reconnaissance-Level Water Quality Rules

Purpose: To evaluate water quality impacts of In-Delta Storage alternatives and identify any violations of WQMP.

Description: Several DSM2 simulations will be conducted, employing Delta hydrology and operations provided by CALSIM studies. DSM2 simulations will utilize daily changing Delta hydrology provided by CALSIM and MAY utilize a non-repeating tide (see Task IV-1). DSM2 simulations will utilize an IDS release water quality module developed in consultation with MWQI staff (see Task IV-2). CALSIM simulations will utilize WQMP constraints developed in Task VI-1 and IDS operations rules developed in Task VI-2. Some iteration in development of IDS operations rules will likely be necessary.

Duration: 6 months

Expected Start Date: July 2001

Expected End Date: January 2002

Product: A draft memorandum report will be prepared summarizing study assumptions and results.

## 3. Finalize Analysis of In-Delta Storage Alternatives

Purpose: To refine the evaluation of water quality impacts associated with In-Delta Storage alternatives.

Description: DSM2 simulations conducted in Task II-2 will be refined utilizing the most current CALSIM studies. CALSIM operations studies will utilize ANNs trained to predict Delta organic concentrations (see Task V-3).

Duration: 3 months

Expected Start Date: January 2002

Expected End Date: April 2002

Product: A memorandum report will be prepared summarizing study assumptions and results.

## **II. DSM2 TOOL AND DATA DEVELOPMENT**

### 1. Develop 16-Year Planning Study Setup With Daily Varying Hydrology/Operations and Non-Repeating Tide

Purpose: To conduct DSM2 water quality planning studies consistent with CALSIM output.

Description: DSM2 planning studies utilize CALSIM hydrology and operations as input. In the past, this input has been provided on a monthly time step. As part of the IDS project, CALSIM will soon be providing Delta hydrology and operations on a daily time step. It is anticipated that DSM2 will provide more meaningful hydrodynamic and water quality responses to daily changing hydrology and operations. Several modifications must be made to the DSM2 planning study setup to accommodate the additional CALSIM input data. The DSM2 planning study setup will also be modified to accommodate a non-repeating tide. In the past, DSM2 planning studies have utilized a 25-hour repeating tide. While such an approach is computationally advantageous, it does not allow for the evaluation of the spring-neap cycle. The DSM2 non-repeating tide will reflect historical conditions. For example, a 16-year planning study (1976-91) will utilize the tidal stage as observed at Martinez for every computational time step (i.e. 15 minutes) of the simulation period.

Duration: 4 months

Expected Start Date: March 2001

Expected End Date: July 2001

Product: DSM2 user documentation will be updated.

## 2. Develop Reservoir Island Release Water Quality Module and Implement in DSM2

Purpose: To simulate water quality changes in In-Delta Storage reservoirs in accordance with best available science.

Description: MWQI consultants and staff will develop a conceptual model and mathematical relationships to describe changes in water quality IDS reservoirs based upon experimental data (SMARTS). Explanatory variables may include diversion quality, residence time, season, water level, and soil characteristics. Delta Modeling staff will collaborate with MWQI staff to develop a water balance module that incorporates the concepts and mathematical relationships developed by MWQI. Delta Modeling staff will develop an appropriate linkage of this module to DSM2. The module could be utilized as a pre-processor or could be dynamically linked to DSM2.

Duration: 4 months

Expected Start Date: March 2001

Expected End Date: July 2001

Product: MWQI staff will prepare a memorandum report, describing model algorithm and assumptions. Delta Modeling staff will update DSM2 user documentation as required.

## 3. Data Development

Purpose: A variety of data development subtasks must be completed to evaluate IDS on a daily time step with DSM2.

- Subtask 3-1 Develop a Data Input Editor -- A tool will be developed to assist in Delta hydrodynamics and water quality time series data visualization, manipulation, and quality control.

Duration: 3 months

Expected Start Date: January 2001

Expected End Date: April 2001

Product: DSM2 user documentation will be updated.

- Subtasks 3-2 Salinity Regression Relationships -- IDS will be operated to meet salinity D-1641 standards or WQMP constraints for EC, chloride, and bromide. CALSIM and DSM2 simulations will be conducted in EC. Model output will be translated into chloride and bromide as necessary to compare with standards and constraints.

Duration: 6 months

Expected Start Date: July 2001

Expected End Date: January 2002

Product: Results will be provided to CALSIM team.

- Subtask 3-3 Real Tide Stage – A 16-year time series of observed tidal stage at Martinez will be developed to use as the downstream boundary condition for DSM2 planning studies. Data will be developed at 15-minute intervals. Data fill-in procedures will be utilized to augment observed data.

Duration: 3 months

Expected Start Date: March 2001

Expected End Date: June 2001

Product: A new data set will be developed and made available through the IEP web page for public review. This data set would be available for future interagency model calibrations and peer reviews.

- Subtask 3-4 Water Temperature Daily Time Series – Predicted TTHM formation at urban intakes is a function of several variables, including water temperature. One annual pattern of monthly averages is assumed to represent all urban intakes. Create a smoothed daily time series from the monthly averages.
- Subtask 3-5 Geometry Changes for Alternative 3 – Make necessary geometry changes in DSM2 input files to represent IDS Alternative 3, which assumes Victoria Island as an IDS reservoir.

- Task 3-6 Develop Habitat Island Assumptions – Implement appropriate assumptions for island diversion volumes, return volumes, and return water quality for habitat islands. Replace assumptions currently in the DICU model for agricultural land use.
- Task 3-7 UVA Conservation – Demonstrate that UVA can be modeled as a conservative constituent. DWR’s Water Quality Assessment staff have been asked to conduct a dilution test to demonstrate.
- Task 3-8 Develop Appropriate Ratios between TOC and DOC. DWR’s Water Quality Assessment staff has indicated that the DOC:TOC ratio is complex and may vary temporally and spatially. Assumed ratios may need to account for seasonal variation. If spatial variation is significant, TOC may need to be simulated directly (instead of DOC).

### **III. CALSIM ARTIFICIAL NEURAL NETWORK DEVELOPMENT AND ENHANCEMENTS**

#### **1. Enhance Existing CALSIM ANN: Phase 1**

Purpose: To improve the predictive ability of the existing CALSIM2 ANN.

Description: The CALSIM salinity ANN will be re-trained with data generated by the most recent calibration of DSM2 (2000 IEP PWT calibration). The ANN approach will be tested for stability under a variety of extreme conditions, including future demand and level of development scenarios.

Duration: 2 months

Expected Start Date: February 2001

Expected End Date: April 2001

Product: This task will result in an improved CALSIM ANN module.

#### **2. Enhance Existing CALSIM ANN: Phase 2**

Purpose: To add features necessary for evaluating salinity impacts of In-Delta Storage alternatives with daily changing hydrology and non-repeating tide over a 16-year planning period.

Description: The CALSIM salinity ANN input structure will be modified to reflect potential IDS facilities and operations. The ANN will be trained on daily-changing hydrology and operations, and will provide daily average salinity output at current D-1641 locations as well as at IDS diversion points and representative urban intakes specified in the WQMP.

Duration: 2 months

Expected Start Date: April 2001

Expected End Date: June 2001

Product: This task will result in a CALSIM ANN module that will insure that the IDS meets salinity objectives outlined in D-1641 and in the WQMP.

### 3. Develop and Implement New CALSIM ANNs for DOC and UVA

Purpose: To develop an efficient CALSIM module that insures that IDS meets organic/DBP objectives outlined in the WQMP.

Description: CALSIM2 will require information on how to operate the In-Delta Storage Project while meeting the WQMP objectives. The operating rules must specify when and how much water should be diverted into storage or released from storage. CALSIM2 is currently provided salinity-based water quality conditions in the Delta through an Artificial Neural Network (ANN) flow-salinity routine. The existing ANN is trained on DSM2 salinity transport simulations. This project will develop new ANNs that provide CALSIM2 with information on organic-based water quality conditions. These new ANNs will be trained on DSM2 simulations of dissolved organic carbon (DOC) and ultraviolet absorbance (UV-254). It is anticipated that the structure of the organic ANNs will be significantly different from the salinity ANN.

Duration: 7 months

Expected Start Date: June 2001

Expected End Date: January 2002

Product: This task will result in a CALSIM ANN module that will insure that the IDS meets organic water quality objectives outlined in the WQMP.

## **IV. CALSIM WATER QUALITY RULES DEVELOPMENT**

### 1. Consult CALSIM Team in Developing Water Quality Constraints

Purpose: To develop CALSIM linear programming constraints that adequately represent the WQMP.

Description: Consult with CALSIM Team to interpret the Delta Wetlands WQMP. Assist in identifying key water quality constraints and formulating representative linear programming constraints.

Duration: <1 month

Expected Start Date: March 2001

Expected End Date: July 2001

Product: The CALSIM team will develop LP constraints that appropriately represent the WQMP.

#### 2-4. Develop Reconnaissance-Level Water Quality Rules for In-Delta Storage Operations

Purpose: To develop simplified CALSIM operating rules that insure that the In-Delta Storage Project meets organic/DBP objectives outlined in the WQMP.

Description: CALSIM2 will require information on how to operate the In-Delta Storage Project while meeting the WQMP objectives. The operating rules must specify when and how much water should be diverted into storage or released from storage. CALSIM2 is currently provided salinity-based water quality conditions in the Delta through an Artificial Neural Network (ANN) flow-salinity routine. Our intent is to develop new ANNs that provide CALSIM2 with information on organic-based water quality conditions. However, our experience with ANN development indicates that such a project may extend beyond the timeframe of the Program. Therefore, we intend to develop simplified operating rules in parallel with ANN development. Simplified operating rules will be developed through a trial-and-error DSM2 simulation approach. The following subtasks are identified:

1. Diversion Rules
2. Diversion Water Quality Specification
3. Release Rules

Duration: 4 months

Expected Start Date: March 2001

Expected End Date: July 2001

Product: A draft memorandum report will be prepared summarizing study assumptions and results.

#### 5. Develop New CALSIM Cross Delta Flow Relationships

Purpose: To develop new CALSIM relationships that estimate flows through the Delta Cross Channel and Georgiana Slough.

Description: The existing relationship, which predicts Cross Delta flow as a function of Sacramento River flow, is inadequate when utilized on a daily time step. A new relationship will be developed with DSM2 data. The new relationships will be a function of Sacramento River flow, Mokelumne and Cosumnes Rivers flow, and Yolo Bypass flow.

Duration: <1 month

Expected Start Date: May 2001

Expected End Date: June 2001

Product: Multivariate regression equations will be provided to CALSIM team. A draft memorandum will be prepared summarizing study assumptions and results.